

EMC-6 EMC-6L

Hybrid Fan Controller User Manual



www.hctcontrols.com

Revision Record

Rev	Description	Date Released	Last Updated by
Rev A	Initial Revision	9-May-14	WB
Rev A.1	E-fan and hydraulic fan auto reverse curves updated	2-Jun-14	WB
	controller weight is added, format updated	27-Jun-14	WB
Rev A.2	Updated product photo on cover page	4-Oct-14	BC

Contents

Revision Record.....	2
HCT Introduction	4
Product Use Limitations	4
Product Application Guidelines	5
Controller Specification	6
Controller Dimensions / Mounting Information.....	7
Wiring Diagram	8
PINOUT.....	9
LEDs / Diagnostic Codes	10
Accessories.....	11
Example Applications.....	12
GUI Installation	13
GUI Overview.....	14
File	15
Controller	15
Password	16
Help.....	17
Exit	17
Dashboard	18
Control Messages.....	20
Stimulus Settings	22
Analog Inputs	24
Bank Control	25
Bank Interlocks	29
Interlock Selection.....	29
Manual Control.....	31
Global Settings.....	33
View Graphs	36
Appendix A Fan Status Messages.....	37
Appendix B Troubleshooting Communication Port Adapters	39

HCT Introduction

Welcome to **High Country Tek** Inc. HCT is North America's foremost independent designer and producer of modular, ruggedized digital and analog electronic controllers for the fluid power industry.

From our factory in California, we manufacture 'specialty' controllers for specific functions and the user programmable 'DVC family' to enable large area networked system solutions.

The modules are used in mobile, industrial and marine applications. They are also applied successfully in other industry segments.

HCT products are encapsulated in solid flame resistant material for maximum durability, electrical integrity and complete environmental security.

HCT is a market leader in many application arenas, including hydraulic generator, *e-Fan* and hydraulic fan system controls. These controllers facilitate significant fuel, emission and operational savings.

HCT's market neutrality offers integration with any hydraulic OEM valves, pumps, sub-systems or systems.

For more information, please visit us at: www.hctcontrols.com.

Product Use Limitations

HCT products may not be suited for any of the following applications:

- Any product which comes under the Federal Highway Safety Act, namely steering or braking systems for passenger-carrying vehicles or on-highway trucks.
- Aircraft or space vehicles.
- Ordinance or military equipment.
- Life support equipment.
- Any end product which, when sold, comes under U.S. Nuclear Regulatory Commission rules and regulations.

HCT does not have any performance assurance programs for testing their products for the above applications.

HCT's products are not designed for these applications and HCT does not warrant, recommend, or specifically approve its products for these applications.

The user shall be solely responsible for any loss or damages occasioned by breach of the provisions of this paragraph and shall carry product liability and liability insurance to insure against such loss or damages.

Cautions

Changing setup values or operating modes while a machine is running may cause unintended machine movement. It could lead to possible **injury** or **death**. Any moving parts should be disabled prior to changing setup values or operating modes. In every case, exercise caution and work should be completed only by qualified personnel.

Product Application Guidelines

ALWAYS do the following

- FULLY read this manual and accompanying data sheets BEFORE starting.
- Isolate this unit from all other equipment BEFORE any form of welding.
- Isolate the controller from ANY form of battery charging or battery boosting.
- Be aware of the electrical & mechanical connections, and the expected reactions of the equipment.
- Operate the units within the temperature range.
- Use the correct tools to do the job (i.e. P.C., software) etc.
- Separate High Voltage AC cables from Low Voltage DC signal and supply cables.
- Make sure power supply is CORRECT, ELECTRICALLY CLEAN, STABLE, and rated for the full load.
- Make sure the controller output voltage & current is compatible with the equipment.
- All unused wires / terminals should be terminated safely.
- Ensure ALL connectors have no unintended SHORT or OPEN circuits.
- Ensure ALL connectors are wired correctly, secure, locked in place and fully connected.
- Disconnect or connect wires to or from this unit only when the power supply is disconnected.
- Use adequate screening in areas of intense Radio Frequency fields.
- Ensure ALL work areas are clear of personnel before operating the controller.
- Follow and abide by local and country health & safety standards.

Controller Specification

Housing Type	HCT encapsulated block, flameproof
Power Supply Voltage	9 to 32VDC (<i>Absolute Maximum</i>)
Current Consumption	Load current + 200mA Quiescent (<i>Max</i>)
Command Inputs	Programmable SAE J1939 CAN messages 3x option selection switches (<i>ON/Off</i>) 12x inputs for fan diagnostics (<i>ON/Off</i>) 6x inputs for sensors or Potentiometers (Max temp = 50Ω, min temp = 2MΩ)
Outputs	Up to 3x 0-5Vdc @ 10mA analog outputs Up to 6x 0-100% PWM (<i>Sourcing for EMC-6, Sinking for EMC-6L, max 500mA, short circuit protection</i>) 1x 3A Proportional PWM current output 1x 3A on/off output for reverse coil 1x 0.5A on/off output for alarm indicator 1x 5V±5% regulated reference voltage
PWM Freq.	Software adjustable - 33 to 500Hz
Module Connector	48-way Cinch 1.5mm SHS Header, Cinch PN: 581 01 48 011
Communication	Mini USB or 4-way Weatherpak for RS232
Housing Material	Black, Polycarbonate
Encapsulation	Flameproof epoxy resin
Mounting	2x ¼" x20 SAE Grade 2 screws
Temperature Range	-40 to +85°C (<i>Operational</i>) -60 to +90°C (<i>Storage</i>)
NEMA/IP Rating	NEMA 6P/IP68
CAN Data Rate	250Kbps, 500Kbps and 1000Kbps

Controller Dimensions / Mounting Information

- Controller weight is approximately 1.26Lbs.
- Mount controller in an easily accessible location.
- Mount controller to a flat surface.
- If mounting to a hydraulic product, allow at least a 2mm air gap underneath the unit.
- Use BOTH mounting holes with correct hardware.
- DO NOT mount controller with connector facing UP if possible.
- Recommended, ¼-20 SAE Grade 2 screws, Dry Torque – 4 Ft-lbs, Lubricated – 3 Ft-lbs.

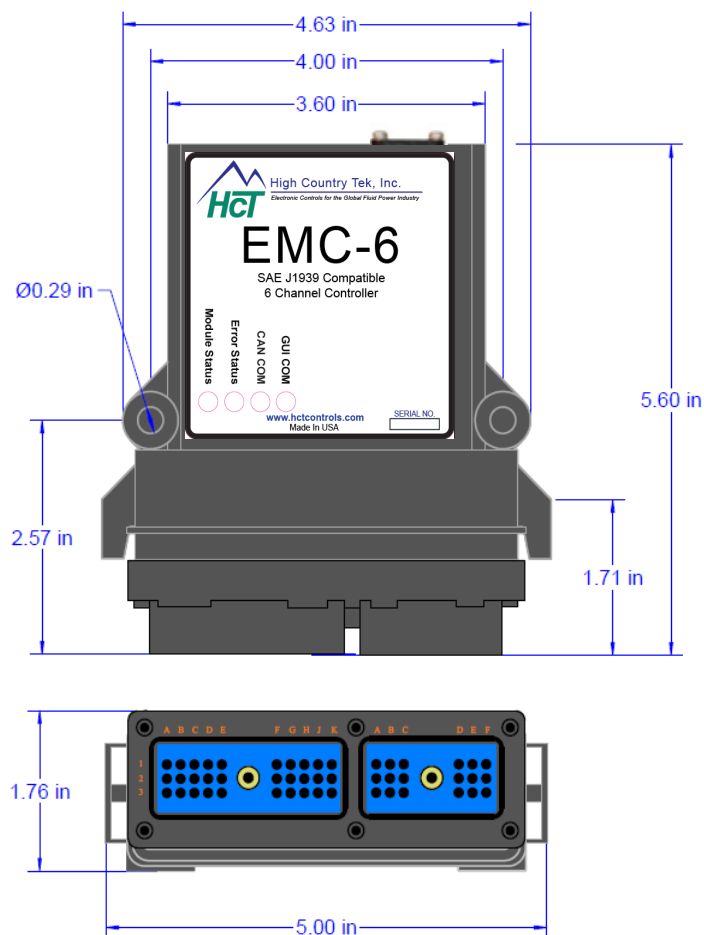


Figure 1

Wiring Diagram

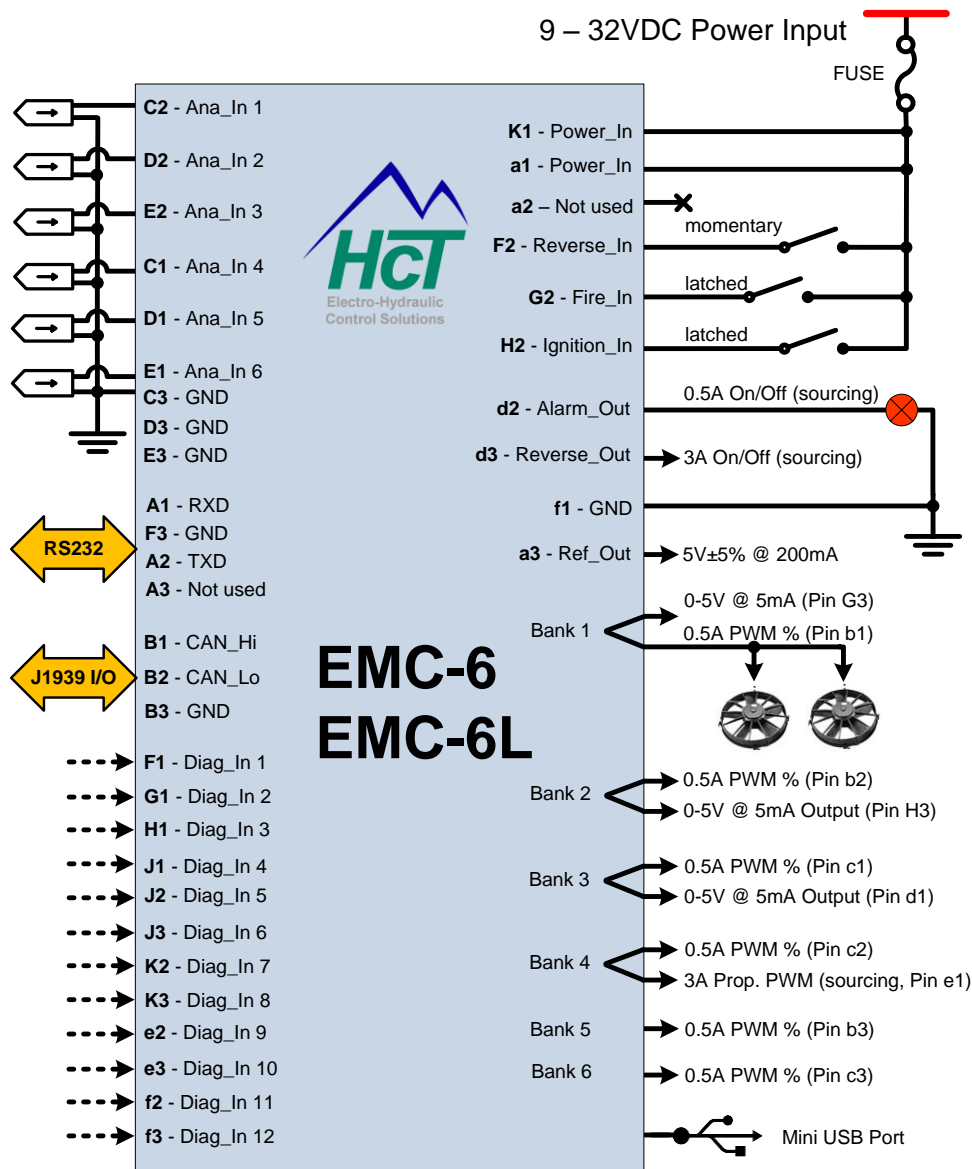


Figure 2

PWM% outputs are sourcing for EMC-6. PWM% outputs are sinking for EMC-6L.

PINOUT

The module has a 30-Pin Cinch connector and an 18-Pin Cinch connector. Either the RS232 port from the 30-pin Cinch connector or the mini USB port at the top of the controller can be used for serial communication.

EMC-6/EMC-6L Connector Designation Table					
30 Pin Metri-Pak Connector (Male, Plug)					
PIN	Name	PIN	Name	PIN	Name
A1	RXD (RS232)	F1	Diag_In 1	J1	Diag_In 4
A2	TXD (RS232)	G1	Diag_In 2	J2	Diag_In 5
A3	Not used	H1	Diag_In 3	J3	Diag_In 6
C1	Therm_In 4	F2	Reverse_In	K1	Power_In
C2	Therm_In 1	G2	Fire_In	K2	Diag_In 7
C3	GND	H2	Ignition_In	K3	Diag_In 8
D1	Therm_In 5	F3	GND	B1	CAN_Hi
D2	Therm_In 2	G3	Bank 1 An_Out	B2	CAN_Lo
D3	GND	H3	Bank 2 An_Out	B3	GND
E1	Therm_In 6	E2	Therm_In 3	E3	GND

EMC-6/EMC-6L Connector Designation Table					
18 Pin Metri-Pak Connector (Male, Plug)					
PIN	Name	PIN	Name	PIN	Name
a1	Power_In	c1	Bank 3 PWM	e1	Bank 4 3A
a2	Not used	c2	Bank 4 PWM	e2	Diag_In 9
a3	Ref_Out	c3	Bank 6 PWM	e3	Diag_In 10
b1	Bank 1 PWM	d1	Bank 3 An_Out	f1	GND
b2	Bank 2 PWM	d2	Alarm_Out	f2	Diag_In 11
b3	Bank 5 PWM	d3	Reverse_Out	f3	Diag_In 12

LEDs / Diagnostic Codes

The module has 4 LEDs.

GUI LED blinks GREEN -----	Normal communication
GUI LED steady GREEN -----	No communication
CAN LED steady RED and Error Status blinks GREEN -----	CAN message timeout
CAN LED blinks RED -----	Intermittent CAN message timeout
CAN LED blinks green fast -----	Normal operation
Error Status LED steady GREEN -----	Normal operation
Error Status LED blinks RED 1~6 times -----	Bank #1-6 diagnostic error.
Error Status LED blinks GREEN 1 time -----	CAN message timeout
Error Status LED blinks GREEN 2 times -----	Analog value out of range
Error Status LED blinks GREEN 3 times -----	CAN value out of range
Error Status LED blinks GREEN 4 times -----	Reference Voltage low
When multiple errors occur, the LED sequences through the error codes.	
Module status LED steady GREEN -----	Normal operation
Module status LED blinks RED/GREEN -----	Reverse cycle
Module status LED steady RED -----	Fire
Module status LED blinks GREEN -----	Low voltage
Alarm indicator blinks RED 1~6 times at 0.5 seconds intervals -----	Bank #1-6 diagnostic error
Alarm indicator sequences through the error codes -----	Diagnostic errors on more banks
Alarm indicator steady red -----	J1939 times out
Alarm indicator blinks red 1 time at 1.0 seconds intervals -----	Any fan bank in reverse

Accessories



999-10104

30-pin Harness (3M length)



999-10107

18-pin Harness (3M length)



999-10077

48-pin Mating Connector Kit



CD-EMC-6

PC set-up software
System diagnostics
Data logging feature



108-00134

USB Mini B
(2M length)



999-10075

4-way weatherpak
to RS232



108-00119

RS232 to PC USB



206-00083 (3/8"-18NPT)
206-00083M (M12x1.5)

Liquid thermistor
-40°C to +150°C.



999-10213 (Mating connector)

For both liquid and dry
thermistors



206-00084 (3/8"-18NPT)

Dry Thermistor
-40°C to +150°C.

Example Applications

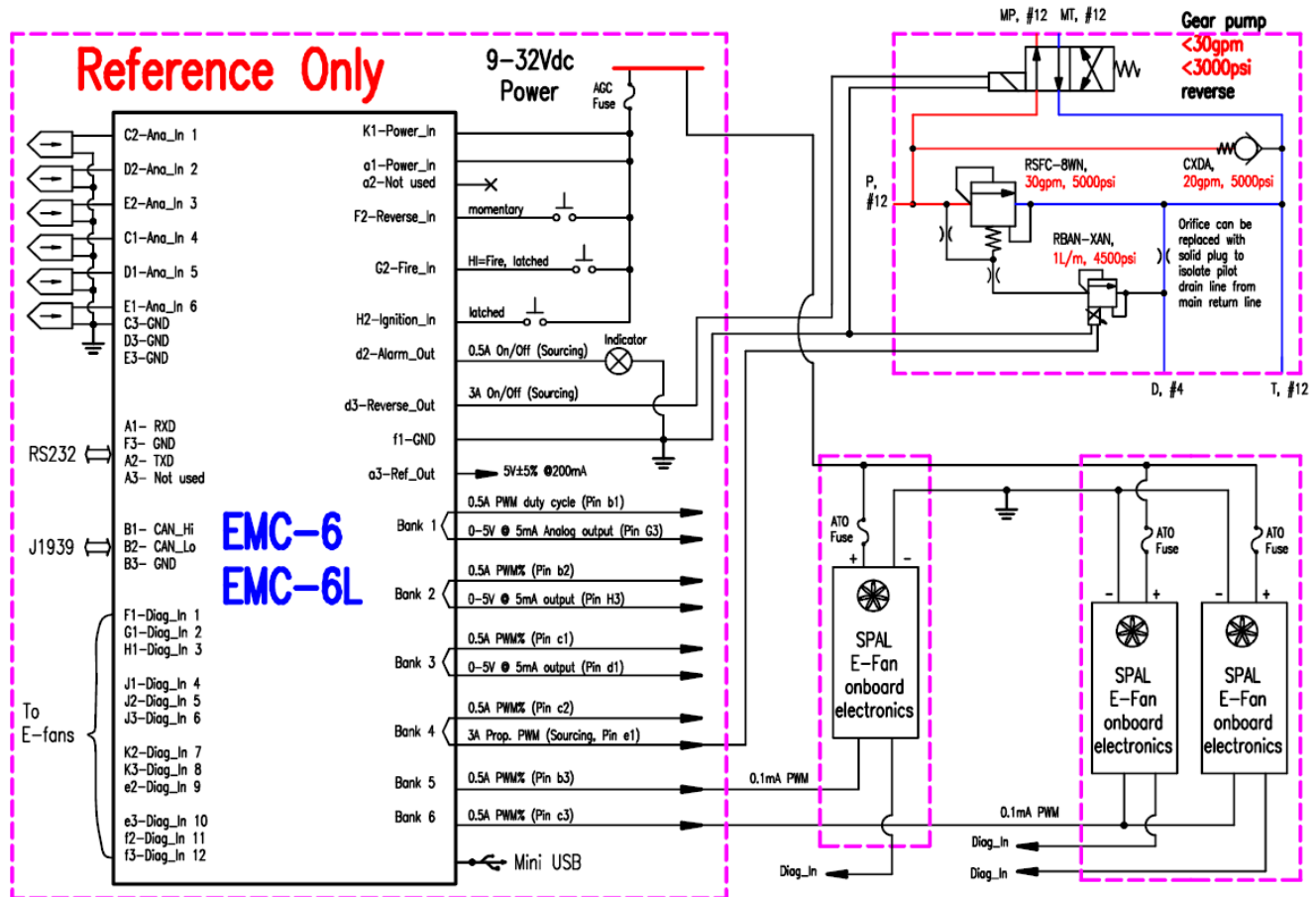


Figure 3

GUI Installation

Use the default file locations for easy future update when installing the Graphical User Interface (GUI). The user has the option to choose file location.

Do NOT run the GUI from a network drive as it needs to access certain files only in the local Windows directories.

System Requirements

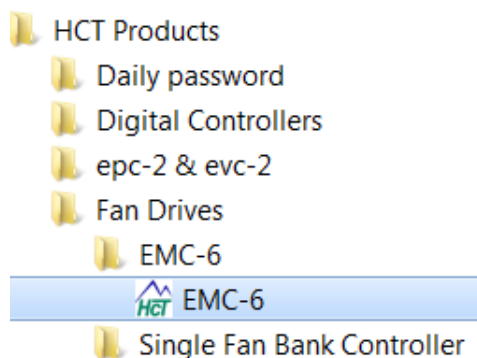
- Windows XP, Vista, Windows 7 or 8, 100MB or greater free disk space.

Installation Steps

- Insert the CD and follow the on screen instructions. This will install the GUI, manual and help files.
- Go to Help menu, install the CommFront driver or Mini USB driver.
- To insure a complete install for CommFront, install it twice.
- Install all software and drivers before plugging in the USB dongle or USB cable.

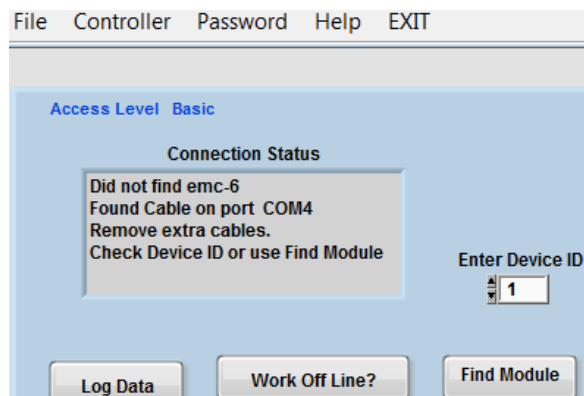
Launch the GUI

Click Start ⇒ HCT Products ⇒ Fan Drives ⇒ EMC-6



GUI Overview

At start up the GUI searches all the PC communication ports and identifies the controller. The GUI appears once the module is identified.



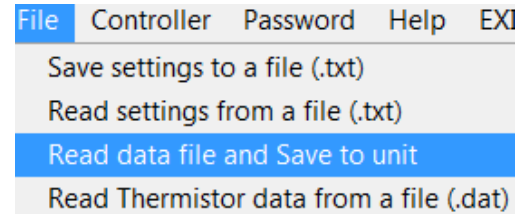
- **Device ID** – Determines the module's PGN addresses on the SAE J1939 bus. The user may command multiple EMC-6 modules on a single SAE J1939 bus. The default **Device ID** is 1.
- **Log Data** – logs the operational data in Excel format. See page 19 for details.
- **Work Off Line** – allows the user to work with GUI offline without the module. The user can load any existing data files, modify them or create new data files and save them to the PC without an OEM password.
- **Find Module** – the GUI tries to find the controller and reconnect it.

The EMC-6 can also be powered by a +5V USB to allow configuration without a 12/24VDC system.

The user may communicate, change, and save settings to the unit without connecting to the E-Fans.

File

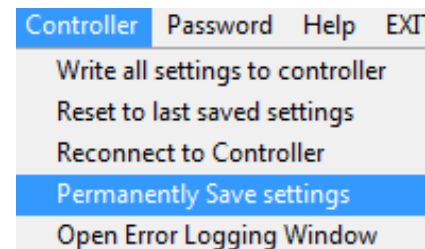
- **Save settings to a file (.txt)** – saves the settings to a data file that may be loaded into any EMC-6 controller.
- **Read settings from a file (.txt)** – loads the data file from the PC to the EMC-6 GUI. At this point the data is not written to the controller yet.
- **Read data file and Save to unit** – loads the data file from the PC, writes to the controller and permanently saves the settings.
- **Read Thermistor data from a file (.dat)** – loads the thermistor data file from the PC to the GUI to match the thermistor in the system. The data are not written to the controller yet.



Settings not permanently saved will be lost after a power cycle.

Controller

- **Write all settings to controller** – executes all “send new settings” on every Tab and saves settings to Volatile Memory (RAM). It does not save settings permanently, a Power Cycle will restore permanently saved settings.
- **Reset to last saved settings** - like a Power Cycle, the module reloads the settings permanently saved in Non-Volatile Memory.
- **Reconnect to Controller** – the GUI resets communication with the module, re-reads and updates all variables.
- **Permanently Save settings** – saves the settings to its Non-Volatile Memory (permanent memory).
- **Open Error Logging Window** – opens the internal data logging windows that display the error situations, such as the count of timeouts, coil open/shorts, fire input ON, the high and low error when bank stimulus and diagnostics occur.



Logged Error Counts

Read Data Errors Clear All Errors Export Data

Control Messages and Unit Errors Bank Stimulus and Diagnostics

PGN # in HEX or Decimal

Hex ☐ Decimal ☐ Message Time-Out and System Condition

Control Msg. Name	PGN #	SA	Counts
J1939 EEC1	F004	0	0
J1939 ET1	FEEE	0	0
J1939 IC1	FEF6	0	0
J1939 TF	FEF8	3	0
J1939 CM1 (Engine)	E0FF	0	0
J1939 CM1 (Transmission)	E04E	3	0
J1939 IC1	FEF6	0	0
J1939 TF	FEF8	3	0
J1939 EEC1	F004	0	0
J1939 ET1	FE81	0	0
Supply Low			0
Reference Low			0
Unit Overtemp			0
Fire Input On			0

Logged Error Counts

Read Data Errors Clear All Errors Export Data

Control Messages and Unit Errors Bank Stimulus and Diagnostics

Radiator	Low Error	High Error
SPN 190 Engine Speed	0	0
SPN 177 Trans. Oil Temp.	0	0
	0	0
	0	0
Diagnostics Error	0	
Charge Air Cooler	Low Error	High Error
SPN 110 Coolant Temp.	0	0
SPN 177 Trans. Oil Temp.	0	0
	0	0
	0	0
Diagnostics Error	0	
Oil Cooler	Low Error	High Error
SPN 105 Intake Manifold Temp.	0	0
SPN 986 Engine	0	0

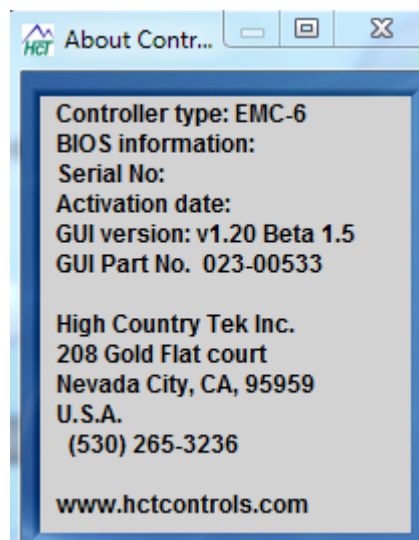
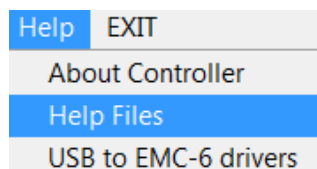
Password

- **OEM Password** – allows full access to view settings, setup data files, apply changes or upload data files to controllers and manual control.

Passwords are '**cAsE SeNsitive**'

Help

- **About Controller** - displays the controller type, BIOS, Serial No, Activation Date, the GUI revision and Part Number, contact information, etc.



- **Help Files** – opens the folder C:\HCT products\Fan Drives/EMC-6 where the manual and other related information are located.
- **USB drivers** – opens the folder where USB driver installation instruction is located.

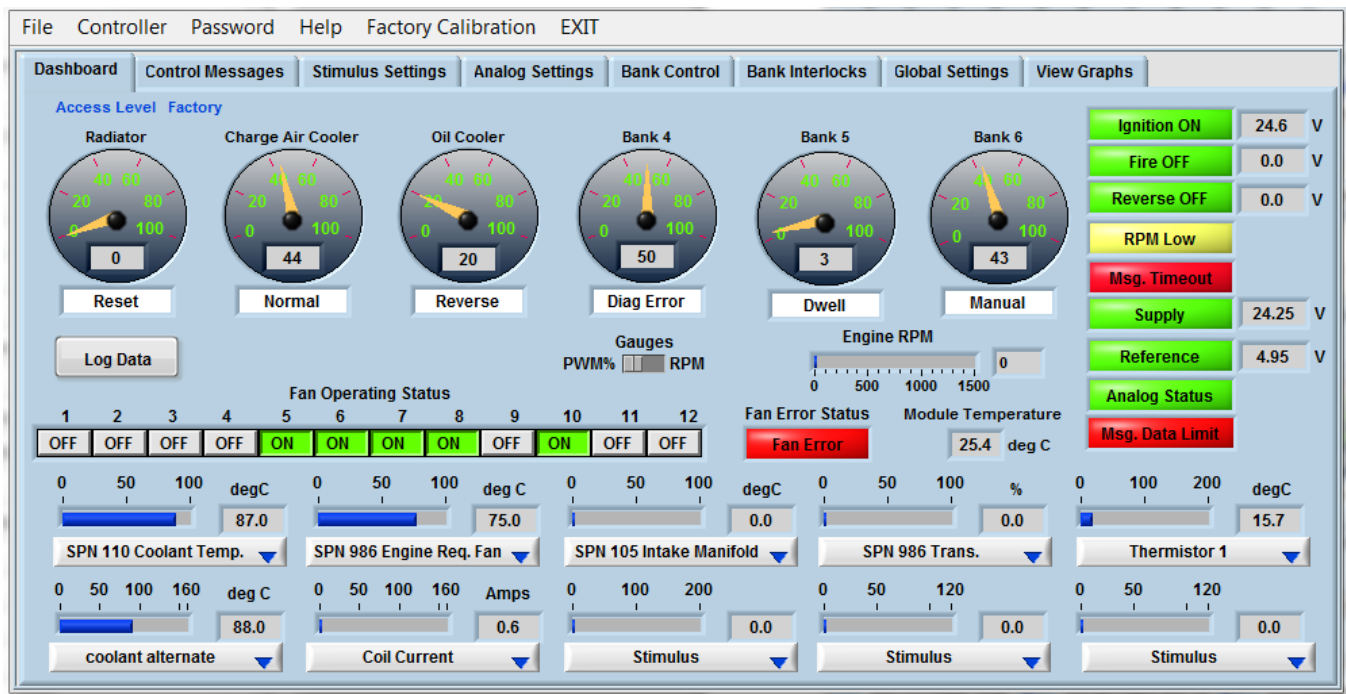
Exit

- **Exit Program** – exits the GUI and frees up the communication port and memory used by the application.

Dashboard

The Dashboard monitors the fan system in real time.

Configure all tabs from left to right so that the subsequent tabs have the correct background settings.



There are six operational states for the fan bank gauges:

- **Normal** – All the fans in this bank are operating normally.
- **Diag. Error** – At least one fan in this bank is reporting an error.
- **Manual** – All the fans in this bank are in manual mode.
- **Reset** – At least one Locked Rotor error was detected. The module is resetting all the fans in this bank.
- **Dwell** – The fans in this bank are freewheeling before entering into reverse direction.
- **Reverse** – The fans in this bank are in Reverse.
- **Engine RPM** - displays the engine RPM from SPN 190, or the error value in “**Stimulus Settings**” when the engine RPM message times out.

- **Log Data** - logs the operational data in Excel format. The file size is only limited by the PC's hard-drive capacity.

Each log begins with a list of settings followed by operational information. The sample rate depends on the workload of the PC and the controller at the recording. A timestamp scales the logs appropriately. Subsequent logs may be saved in a new file or appended to the original file by selecting the original file.

The log file is saved as a .csv file. Microsoft Excel can be used to open this file.

- **Gauges PWM/RPM** – displays either the real time PWM % or the Calculated Fan RPM.
- **Fan Operating Status and Fan Error Status** – indicates the fan status.

Green – indicates that fans are running.

Gray – indicates that fans are OFF.

Red – indicates one or more fans have errors. It happens when the respective diagnostic pin does not have voltage when the fan is running; or has voltage when the fan is not running.

Fan ID numbers are assigned in the “**Bank Interlocks**” tab.

- **State Indicators** – displays the state of the inputs, RPM, J1939 messages, Supply voltage and Reference voltage.

Green – the input is on or active.

Yellow – the input is in an intermediate state (i.e. RPM low).

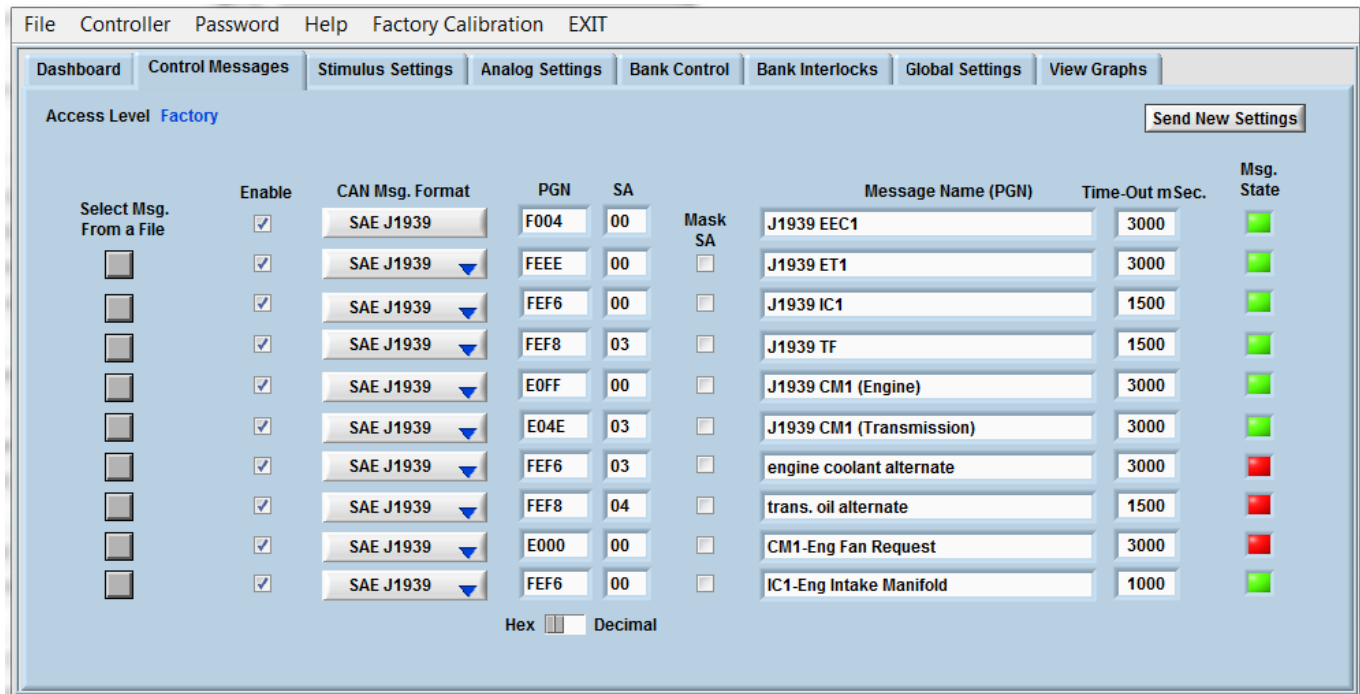
Red – the input is off or timed out, or in an error state like Fire ON.

- **Stimulus Bar Graphs** – displays the read time readings of the stimulus.

Select the stimulus from the pull down menu. Scale the bar graphs. The units are set in the “**Stimulus Settings**” for CAN values and in the “**Analog Settings**” for the Analog Inputs.

Control Messages

The user may define up to 10 CAN messages as the controlling inputs. Currently the EMC-6 supports the SAE J1939 protocol.



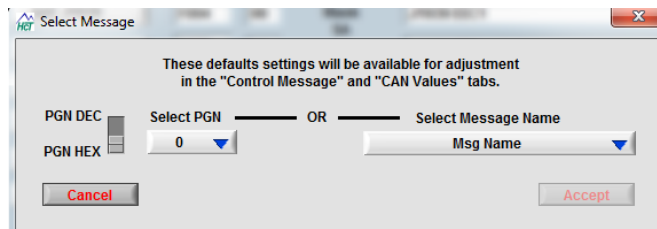
Select Msg. From a File	Enable	CAN Msg. Format	PGN	SA	Mask SA	Message Name (PGN)	Time-Out mSec.	Msg. State
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	F004	00	<input type="checkbox"/>	J1939 EEC1	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEEE	00	<input type="checkbox"/>	J1939 ET1	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEF6	00	<input type="checkbox"/>	J1939 IC1	1500	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEF8	03	<input type="checkbox"/>	J1939 TF	1500	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	E0FF	00	<input type="checkbox"/>	J1939 CM1 (Engine)	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	E04E	03	<input type="checkbox"/>	J1939 CM1 (Transmission)	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEF6	03	<input type="checkbox"/>	engine coolant alternate	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEF8	04	<input type="checkbox"/>	trans. oil alternate	1500	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	E000	00	<input type="checkbox"/>	CM1-Eng Fan Request	3000	■
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SAE J1939	FEF6	00	<input type="checkbox"/>	IC1-Eng Intake Manifold	1000	■

Hex ☐ Decimal ☐

The first message is always EEC1, Engine RPM (hard coded).

To configure Control Messages from a default file included in the GUI installation:

- **Select Msg From a File** – opens the control message file and displays the Message Window.
- **Select PGN** or **Select Message Name**, the GUI will match PGN and Message Name.
- **Accept** or **Cancel** the message.
- **Check** to enable the message.
- Select **SAE J1939** as the **CAN Msg. Format**.
- **Mask SA** – if checked, the source address is ignored. The module can receive messages from any source address for the specified PGN number.



To configure **Control Messages** manually:

- Enter the PGN number, Source Address, Message Name and the message time out in milliseconds.
- **Check** to enable the message.
- Select **SAE J1939** as the **CAN Msg. Format**.
- **Mask SA** – if checked, the source address is ignored. The module can receive messages from any source address for the specified PGN number.
- **Send New Settings** – loads the new settings into the unit's RAM memory and activates these messages.
- **Permanently save settings**

Control messages are now available on the **Stimulus Settings** Tab.

Msg. State

Green – the message is Active.

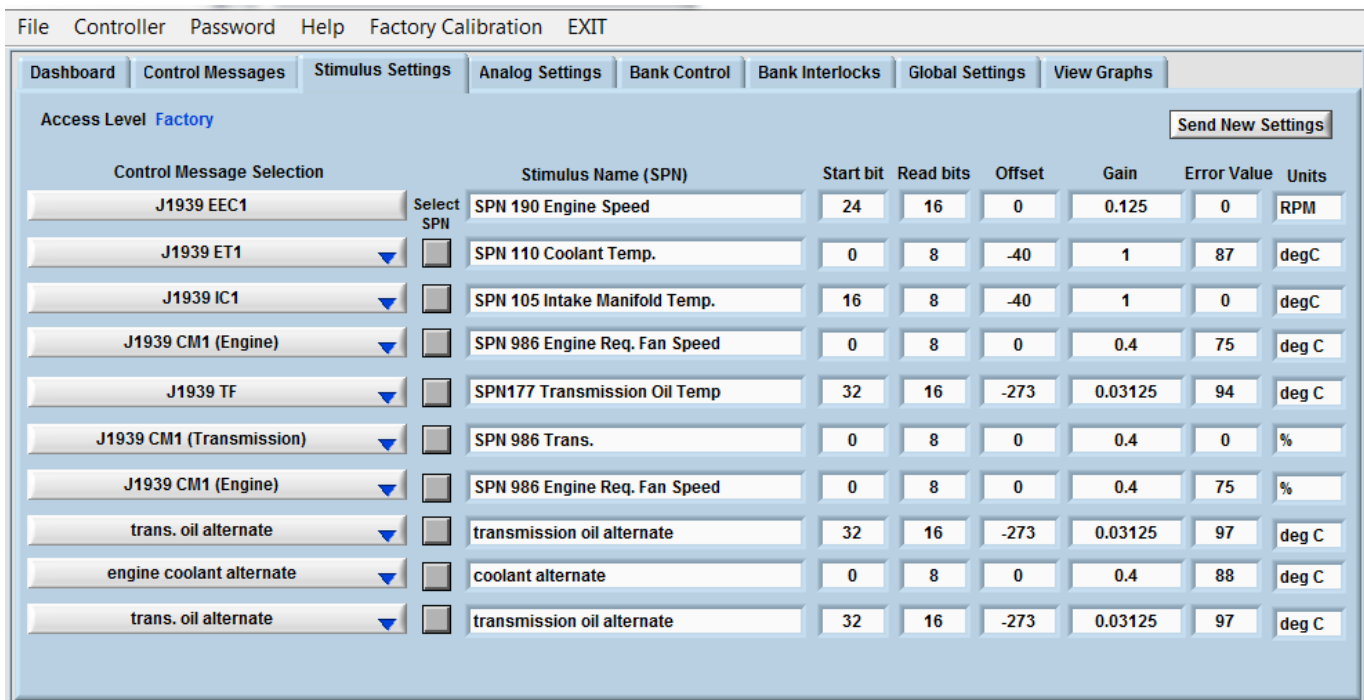
Red – the message is Timed Out.

Grey – the message is Inactive.

Hex-Decimal – switches PGN numbers between Hexadecimal or Decimal format.

Stimulus Settings

The user may define up to 10 CAN messages as the inputs.

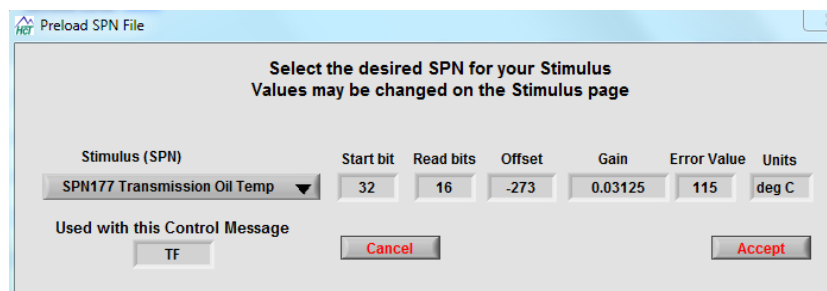


Control Message Selection	Stimulus Name (SPN)	Start bit	Read bits	Offset	Gain	Error Value	Units
J1939 EEC1	SPN 190 Engine Speed	24	16	0	0.125	0	RPM
J1939 ET1	SPN 110 Coolant Temp.	0	8	-40	1	87	degC
J1939 IC1	SPN 105 Intake Manifold Temp.	16	8	-40	1	0	degC
J1939 CM1 (Engine)	SPN 986 Engine Req. Fan Speed	0	8	0	0.4	75	deg C
J1939 TF	SPN177 Transmission Oil Temp	32	16	-273	0.03125	94	deg C
J1939 CM1 (Transmission)	SPN 986 Trans.	0	8	0	0.4	0	%
J1939 CM1 (Engine)	SPN 986 Engine Req. Fan Speed	0	8	0	0.4	75	%
trans. oil alternate	transmission oil alternate	32	16	-273	0.03125	97	deg C
engine coolant alternate	coolant alternate	0	8	0	0.4	88	deg C
trans. oil alternate	transmission oil alternate	32	16	-273	0.03125	97	deg C

The first message is always EEC1, Engine RPM. Only the error value can be changed for this SPN.

To configure Stimulus from a default file included in the GUI installation:

- Select **specific Control Message** from the pull-down menu defined in “**Control Messages**” Tab.
- Select **SPN Selection** text file. A new window will open.
- Select the stimulus from the pull-down menu **Stimulus (SPN)**, the respective values appear automatically.

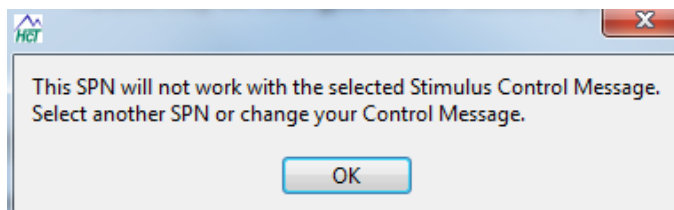


Stimulus (SPN)	Start bit	Read bits	Offset	Gain	Error Value	Units
SPN177 Transmission Oil Temp	32	16	-273	0.03125	115	deg C

Used with this Control Message: TF

The stimulus has to match the control message. E.g., SPN177 Transmission Oil Temperature matches J1939 TF.

- If the **Stimulus** does not match the **Control Message**, this window will appear:



- Match the **Stimulus** to the **Control Message**.
- **Accept** or **Cancel** the selection.
- Enter the **Error Value** on **Stimulus Settings** tab. This will be the stimulus value when this message times out.
- The user can also modify the values on **Stimulus Settings** tab.

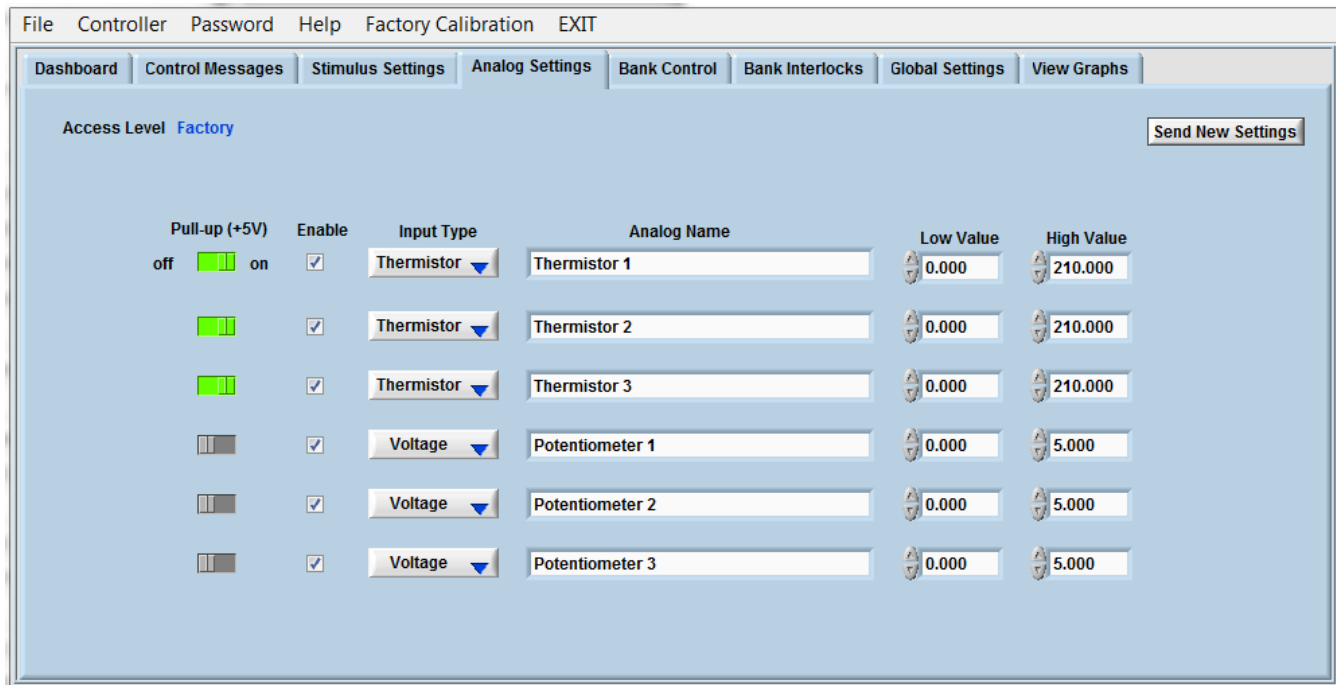
To configure **Stimulus Settings** manually:

- Select **Stimulus** from the list defined in “**Control Messages**” Tab.
- Enter a name in the **Stimulus Name (SPN)**. Use the SPN number and/or a short description.
- Enter values for the following:
 - **Start Bit** – The bit number where the data begins. Bit numbering starts at 0.
 - **Read Bits** – The number of bits in the data package.
 - **Offset** – The offset is applied after the Gain Calculation.
 - **Gain** – The Scale Factor for the Gain Calculation.
 - **Error Value** – the value used for the stimulus when the message times out.
 - **Units** – the unit of the stimulus value.
- **Send New Settings** – loads the new settings into the unit's RAM memory and activates these stimuli.
- **Permanently save settings.**

Stimulus Settings are now available on the **Bank Control** Tab.

Analog Inputs

The user may define up to 6 analog inputs, either thermistor or potentiometer inputs.



Pull-up (+5V)	Enable	Input Type	Analog Name	Low Value	High Value
off <input type="checkbox"/> on <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Thermistor	Thermistor 1	0.000	210.000
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Thermistor	Thermistor 2	0.000	210.000
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Thermistor	Thermistor 3	0.000	210.000
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Voltage	Potentiometer 1	0.000	5.000
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Voltage	Potentiometer 2	0.000	5.000
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Voltage	Potentiometer 3	0.000	5.000

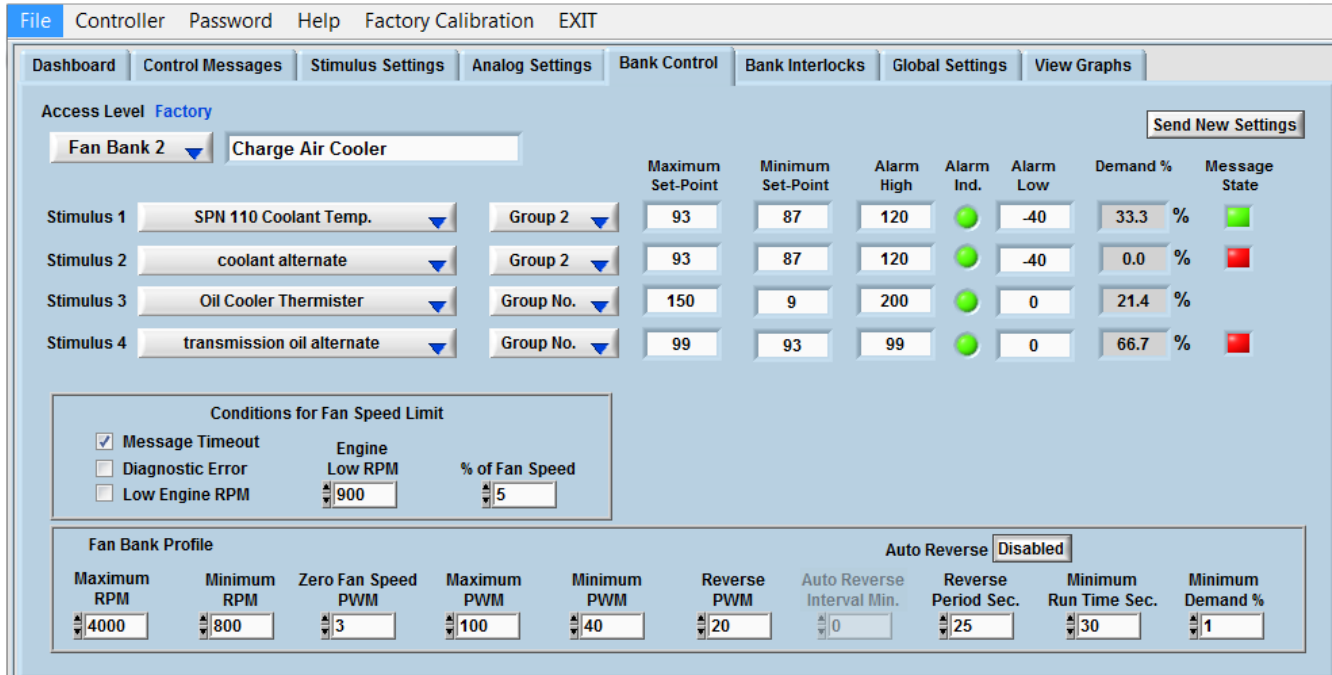
To configure **Analog Settings**:

- **Pull-Up (+5V)** – Select **On** for thermistors. When on, the module sources current for use with resistive thermal devices. Select **Off** for potentiometer or analog inputs.
- **Enable** – **check** to enable the input.
- **Input Type** – Select Thermistor or Voltage type.
- **Analog Name** – name the input.
- **Low Value & High Value** – the minimum and maximum values the sensor can report.
- **Send New Settings** – loads the new settings into the unit's RAM memory and activates these stimuli.
- **Permanently save settings**

Analog Settings are now available on the **Bank Control** Tab.

Bank Control

The user may define independently up to 6 banks of electric fans and up to 1 bank of hydraulic fan.



The screenshot shows the 'Bank Control' tab in the software interface. It displays settings for 'Fan Bank 2' with the name 'Charge Air Cooler'. The 'Access Level' is set to 'Factory'. A 'Send New Settings' button is in the top right. Below this, there is a table of stimulus inputs for four stimuli. Each stimulus has a dropdown menu for the stimulus type, a dropdown for the group, and numerical input fields for Maximum Set-Point, Minimum Set-Point, Alarm High, Alarm Ind. (with a green indicator), Alarm Low, Demand %, and Message State (with a green/red indicator).

Stimulus	Stimulus Type	Group	Maximum Set-Point	Minimum Set-Point	Alarm High	Alarm Ind.	Alarm Low	Demand %	Message State
Stimulus 1	SPN 110 Coolant Temp.	Group 2	93	87	120	Green	-40	33.3 %	Green
Stimulus 2	coolant alternate	Group 2	93	87	120	Green	-40	0.0 %	Red
Stimulus 3	Oil Cooler Thermister	Group No.	150	9	200	Green	0	21.4 %	Green
Stimulus 4	transmission oil alternate	Group No.	99	93	99	Green	0	66.7 %	Red

Below the stimulus table is a section for 'Conditions for Fan Speed Limit' with checkboxes for 'Message Timeout', 'Diagnostic Error', and 'Low Engine RPM'. It also includes input fields for 'Engine Low RPM' (set to 900) and '% of Fan Speed' (set to 5).

At the bottom is the 'Fan Bank Profile' section with input fields for various parameters: Maximum RPM (4000), Minimum RPM (800), Zero Fan Speed PWM (3), Maximum PWM (100), Minimum PWM (40), Reverse PWM (20), Auto Reverse Interval Min. (0), Reverse Period Sec. (25), Minimum Run Time Sec. (30), and Minimum Demand % (1). The 'Auto Reverse' status is set to 'Disabled'.

For each bank, the user may define up to four stimulus inputs.

- **Fan Bank *n*** – selects the fan bank to be configured.
- **Name the Fan Bank *n*** – names the bank to identify it on the GUI.
- **Stimulus** – selects stimuli for this bank. All previously configured stimuli are in the pull down menu. Multiple fan banks may use the same stimuli.
- **Maximum Set-Point** – the stimulus value that makes the fan bank run at full speed.
- **Minimum Set-Point** – the stimulus value that makes the fan bank run at minimum speed.
- **Alarm High** – the stimulus value that trips the High Alarm condition.
- **Alarm Low** – the stimulus value that trips the Low Alarm condition.
- **Demand %** – displays the normalized percentage of demand.
- **Message State** – displays green when normal, red when timed out.

The **Dashboard** will display **Analog Data Error** or **CAN Data Error** when the value meets or exceeds the **Alarm High** or **Alarm Low** setting.

Fan Bank Profile – defines specification of all E-fans in the specific bank:

- **Maximum RPM** – the rated fan Maximum RPM.
- **Minimum RPM** – the rated fan Minimum RPM.
- **Zero Fan Speed PWM** – the PWM % that causes the fan(s) to stop (figure 4).
- **Maximum PWM** – the PWM % that causes the fan(s) to run at maximum RPM (figure 4).
- **Minimum PWM** – the PWM % that causes the fan(s) to run at minimum RPM (figure 4).
- **Reverse PWM** – the PWM % that causes the fan(s) to run in Reverse (figure 4).
- **Auto Reverse Enable/Disable** – enables or disables the Auto Reverse feature.
- **Auto Reverse Interval** (minutes) – see the EMC-6 reverse cycle definition (figure 5). It is the time between the 1st reverse signal and the 2nd auto reverse signal.
- **Reverse Period** (seconds) – see the EMC-6 reverse cycle definition (figure 5). It is the total time of ramp up in reverse direction, full fan reverse time and ramp down time in reverse direction. Ramp up and down time equal to the dwell time set on the “Global Settings”.
- **Minimum Run Time Seconds** – the minimum run time. It prevents the fans from repeatedly starting and stopping when there is low demand and helps reduce thermal cycling in the equipment.
- **Minimum Demand %** – determines the fan minimum speed until the controlling input demands a higher speed. This eliminates the fans start up delay and quickly responds to fast changing heat loads such as Charge Air Coolers etc.
- **Send New Settings** – loads the new settings into the unit's RAM memory and activates these stimuli.
- **Permanently save settings**

Stimulus Grouping – in each fan bank, the inputs can be grouped. The following rules apply:

- Stimulus grouping for one bank does not affect how the same inputs control other banks.
- Analog inputs out of range act the same as J1939 message timeout. Error values take effect for them.
- 100% demand is the error value for thermistor input high, 0% is for thermistor input low.

- For thermistor supported by HCT, the maximum input is 149°C. 150°C is out of range.
- For thermistor supported by HCT, the minimum input is -39°C. -40°C is out of range.
- Within the same group, the highest valid demand takes effect (error values are ignored).
- Within the same group, if there is no valid demand, error values for each stimulus take effect, the highest demand controls the fan rpm.
- The highest demand takes effect when comparing among groups or individual stimulus not grouped.

OEMs may have different configurations and stimulus messages. It allows the OEMs to have 1 data file for up to 4x configurations, reducing possibilities of errors.

Conditions for Fan Speed Limit

- **Message Timeout** – when checked, the fan speed is clipped to the % of fan speed specified by the user if there is a message timeout. If stimulus is grouped, there is no message timeout if there is valid stimulus.
- **Diagnostic Error** – when checked, the fan speed is clipped to the % of fan speed specified if there is diagnostic error.
- **Low Engine RPM** – when checked, the fan speed is clipped to the % of fan speed if engine RPM is lower than the RPM set here, but it has to be higher than the engine minimum RPM in global settings if engine RPM interlock is used.

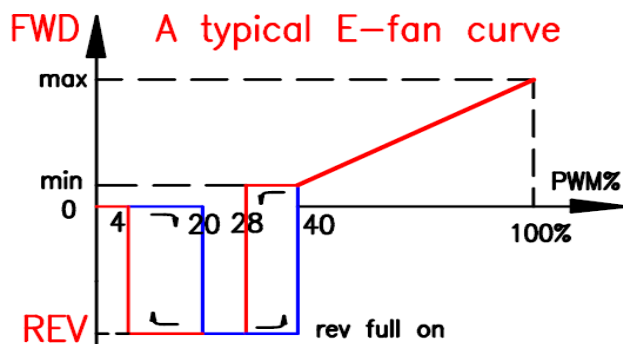


Figure 4

EMC-6 Reverse Cycle Definition

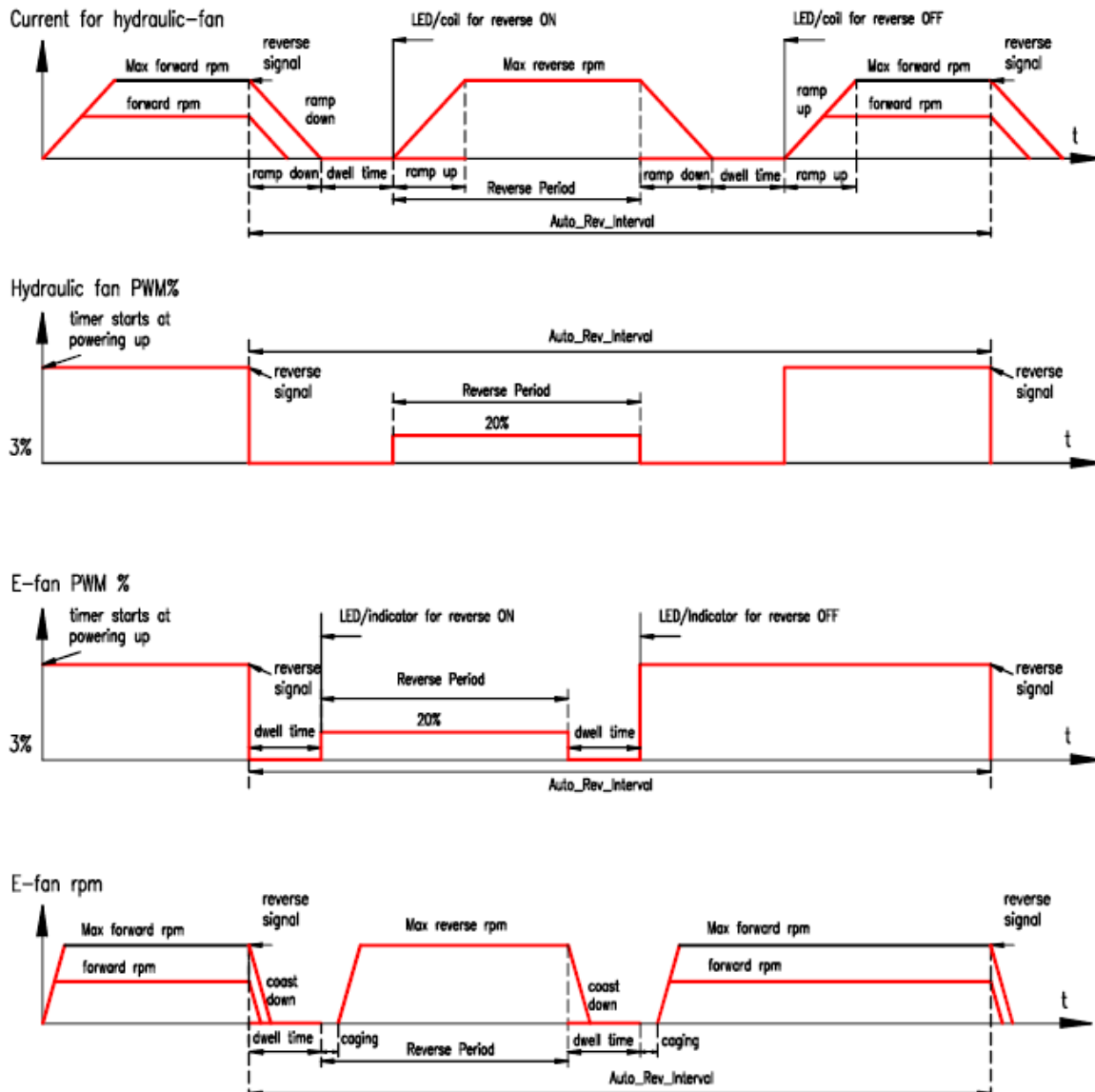
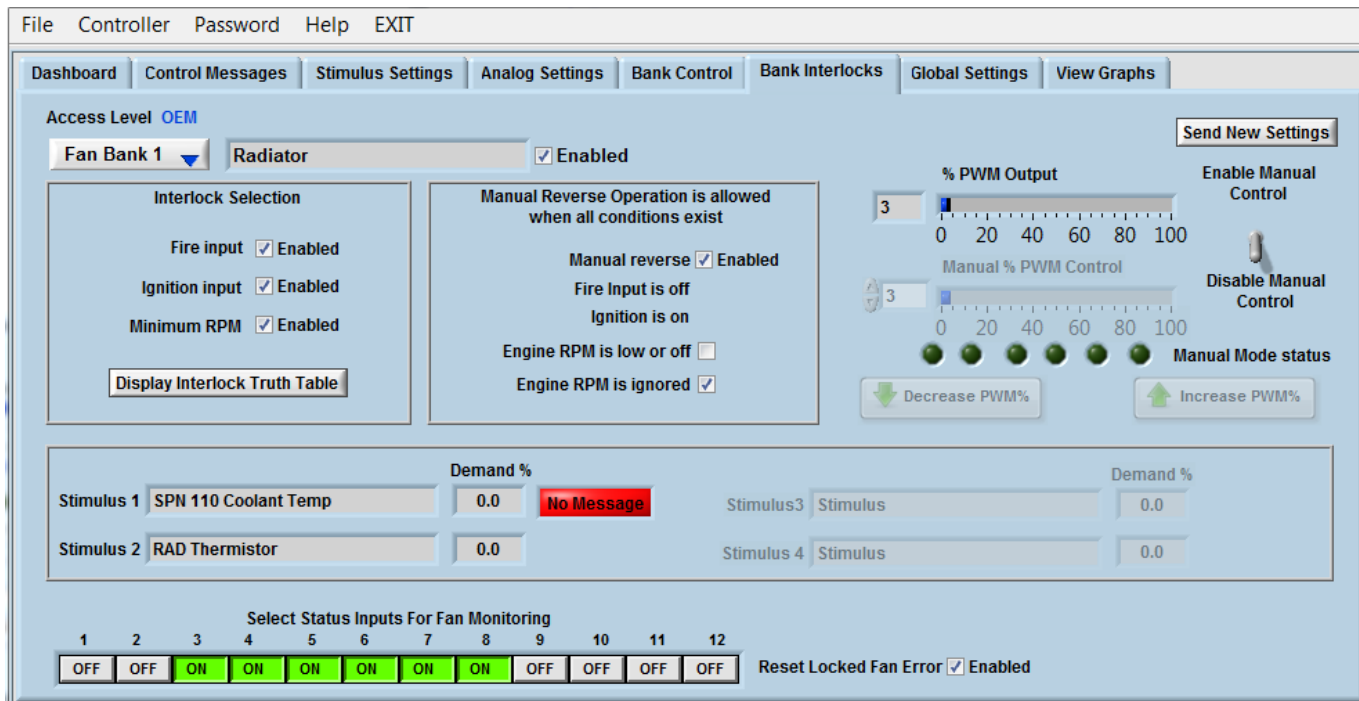


Figure 5

When there are E-fans and hydraulic fan, the LED blinks when any fan bank is in reverse. Reverse coil ON and OFF are determined by hydraulic fan curve.

Bank Interlocks

The user may define interlock logic for each bank.



The screenshot shows the 'Bank Interlocks' configuration window. At the top, there's a menu bar with 'File', 'Controller', 'Password', 'Help', and 'EXIT'. Below it, a tabbed interface includes 'Dashboard', 'Control Messages', 'Stimulus Settings', 'Analog Settings', 'Bank Control', 'Bank Interlocks' (selected), 'Global Settings', and 'View Graphs'. The 'Access Level' is set to 'OEM'. The 'Fan Bank 1' dropdown is selected, and the 'Radiator' interlock is checked and 'Enabled'. The 'Interlock Selection' section has 'Fire input', 'Ignition input', and 'Minimum RPM' all checked and 'Enabled'. A 'Display Interlock Truth Table' button is present. The 'Manual Reverse Operation' section states 'Manual Reverse Operation is allowed when all conditions exist' and has 'Manual reverse' checked and 'Enabled'. It also shows 'Fire Input is off', 'Ignition is on', 'Engine RPM is low or off' (unchecked), and 'Engine RPM is ignored' (checked). The '% PWM Output' section shows a slider at 3% and a 'Send New Settings' button. The 'Manual % PWM Control' section has a slider at 3% and buttons for 'Decrease PWM%' and 'Increase PWM%'. The 'Manual Mode status' section has 'Enable Manual Control' and 'Disable Manual Control' buttons. The 'Stimulus' section shows 'Stimulus 1' as 'SPN 110 Coolant Temp' with a 'Demand %' of 0.0 and a 'No Message' status. 'Stimulus 2' is 'RAD Thermistor' with a 'Demand %' of 0.0. 'Stimulus 3' and 'Stimulus 4' are both 'Stimulus' with 'Demand %' of 0.0. The 'Select Status Inputs For Fan Monitoring' section shows 12 inputs: 1 (OFF), 2 (OFF), 3 (ON), 4 (ON), 5 (ON), 6 (ON), 7 (ON), 8 (ON), 9 (ON), 10 (OFF), 11 (OFF), 12 (OFF). A 'Reset Locked Fan Error' checkbox is checked and 'Enabled'.

- **Fan Bank *n*** – selects the fan bank to be configured.
- **Name Text Box** – displays the fan bank name defined in the **Bank Control** tab.
- **Enabled – check** to enable the fan bank.

Interlock Selection

- **Fire Input** – check to enable the input. The fire input will override all controlling inputs. When enabled, this fan bank stops when the input is high. Manual mode overrides the fire input.
- **Ignition Input** – check to enable the input. When enabled, this fan bank stops when the input is low.
- **Minimum RPM** – check to enable the input. When enabled, the fan bank will not run until the Engine RPM meets or exceeds the Minimum Engine RPM set point on **Global Settings**.

Refer to the following truth table for using more than 1 interlock.

- **Display Interlock Truth Table** – opens a window that displays a table of the interlock logic.

Interlock Truth Table

Fire input takes precedence when enabled, and turns off All Fans

Selection	Selection	Condition	Condition	Condition	Condition	Result
Minimum RPM	Ignition Input	RPM > Minimum	RPM < Minimum	RPM Msg. Time Out	Ignition On	Fan Bank
0	0	X	X	X	X	Enable
1	0	1	0	0	X	Enable
1	0	0	1	0	X	Off
1	0	0	0	1	X	Enable
0	1	X	X	X	1	Enable
0	1	X	X	X	0	Off
1	1	1	0	0	X	Enable
1	1	0	1	0	X	Off
1	1	0	0	1	1	Enable
1	1	0	0	1	0	Off

Manual Reverse Configuration

Manual Reverse Operation is allowed only when the fire input is off and the ignition is on unless the inputs are disabled in the Interlock Selection Box.

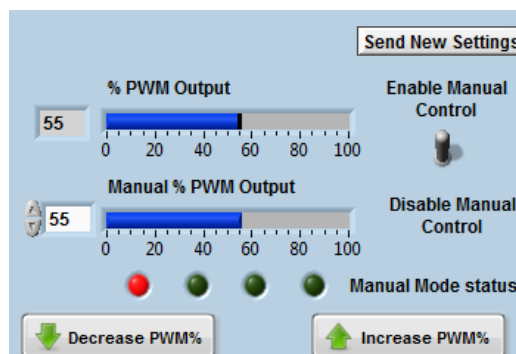
- **Manual Reverse** – check to enable it. When disabled, this fan bank has no Manual Reverse.
- **Engine RPM is Off/low** – if checked, this fan bank has Manual Reverse when the Engine RPM is lower than the Minimum Engine RPM setting on **Global Settings** or 0rpm. Engine J1939 message timeout does not qualify as 0rpm.
- **Engine RPM is ignored** – check to enable it. This will cancel Engine RPM is OFF/Low. When enabled, engine RPM is irrelevant to this fan bank's Manual Reverse.

When ignition input is disabled, make sure nobody is working on the fans when switching on manual reverse with ignition OFF.

Manual Control

The user may manually verify that the E-fans are working properly and determine the maximum, minimum and reverse PWM duty cycles.

- **Enable / Disable Manual Control** – turns On/Off manual control.
- **% PWM Output** – displays the PWM duty cycle output for this fan bank.
- **Manual % PWM Output** – displays the command input for this fan bank. To change the input, the user can drag the bar or type the value or increase/decrease arrow.
- **Manual Mode Status** – The indicators are dark when the banks are in normal mode and Red when the banks are in manual mode.



Caution

- Only allowed with the OEM password.
- All settings on this tab will immediately affect the output.
- All limits and controls are bypassed.
- The controller goes back to normal operation when disabling the manual mode.
- Cycling power on the unit will exit the manual model.
- Disconnecting the communication cable will exit manual mode.

Select Status Inputs for Fan Monitoring

The EMC-6 has 12 discrete Fan Diagnostic Inputs (DG). Each Diagnostic Input should only be assigned to one fan bank. Turn the buttons to ON if DG inputs are connected to this fan bank. Ensure all the others are OFF.

- **Reset locked fan error** – check to enable it. When enabled, the controller will set the fan bank PWM % to 0 to restart the failed fans after the fans give up restarting by themselves. The period for resetting the fans is set on **Global Settings**.

Select Status Inputs For Fan Monitoring											
1	2	3	4	5	6	7	8	9	10	11	12
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

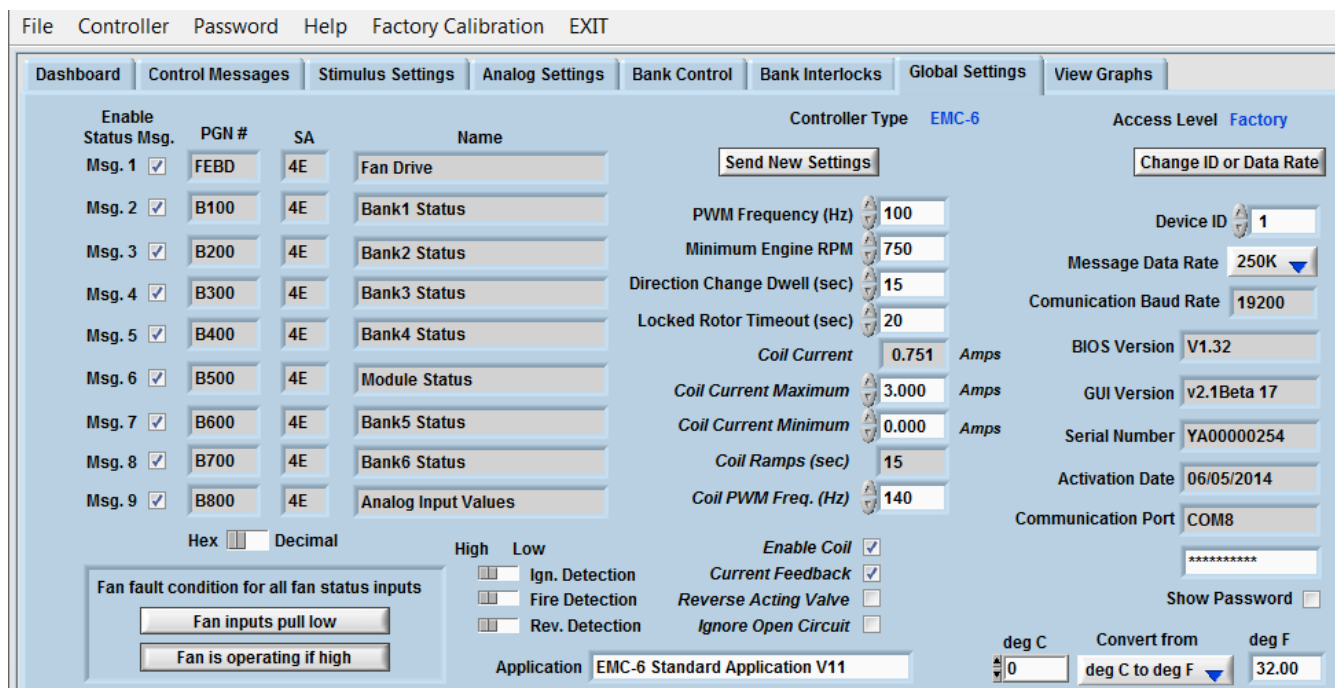
Reset locked fan error ☒ Enabled

On the same page GUI also displays the real time demand and status of all the stimuli.

- **Send New Settings** - loads the new settings into the unit's RAM memory and activates these stimuli.
- **Permanently save settings**

Global Settings

The parameters on this page apply to all the banks.



The EMC-6 can transmit the module status messages via SAE J1939. Check to enable the messages. The Source Address (SA) for the EMC-6 module is 78 (0x4E). See the **Appendix A** for more details.

- **PWM Frequency (Hz)** – is the PWM frequency for all E-fan banks.
- **Minimum Engine RPM** – is the Minimum Engine RPM that the EMC-6 considers the engine is running normally.
- **Direction Change Dwell (Seconds)** – see the EMC-6 reverse cycle definition (figure 5). For hydraulic fan, dwell time equals the ramp down and ramp up time (fan changes from max rpm to 0 or vice versa). For E-fan, dwell time is the coast down time plus 0rpm time before entering reverse cycle and getting out of reverse cycle.
- **Locked Rotor Timeout (Seconds)** – sets the period that the EMC-6 will reset the failed fans after fans give up restarting by themselves. This only works if **Reset locked fan error** is enabled on the **Bank Interlocks** section.

- **Coil current** – displays the valve current in real time.
- **Coil Current Maximum** – is the maximum current for the proportional hydraulic valve (up to 3A).
- **Coil Current Minimum** – is the minimum current for the proportional hydraulic valve.
- **Coil PWM Freq. (Hz)** – is the PWM frequency for the hydraulic valve.
- **Enable Coil** – check to enable 3A output.
- **Current Feedback** – check to have constant current control. Uncheck to have PWM duty cycle control for the hydraulic valve.
- **Reverse Acting Valve** – check to have a reverse acting hydraulic valve, uncheck to have normal acting hydraulic valve.
- **Ignore Open Circuit** – when checked, the controller will not detect open circuit.

When coil max current is set high and PWM output is 100%, controller will not declare coil open, it will only lose “current feedback” by outputting lower current when coil temperature goes up or battery voltage drops. It does not matter whether “**Ignore open circuit**” is checked or not.

- **Fan Fault Conditions** – sets how the module interprets the DG inputs for all fans.
 - **Fan Inputs Pull Low/High** – Pull High is used when the fan provides an active low DG signal. Pull low is used when the fan provides an active high DG signal.
 - **Fan Is/Is Not Operating if Low/High** – Determines the active state of the DG input.
- **Ignition Detection, Fire Detection, Reverse Detection** – when setting high, the inputs are ON when the input voltage is higher than 8V. When setting low, the inputs are OFF when the input voltage is higher than 8V.
- **Application Name** – name to identify the application.
- **Send New Settings** - loads the new settings into the unit's RAM memory and activates these values.
- **Permanently save settings**

Device Settings

- **Device ID** – Determines the module's PGN addresses on the SAE J1939 bus. The user may install multiple EMC-6 modules on a single SAE J1939 bus. The default **Device ID** is 1.
- **Message Data Rate** - is the CAN data rate. EMC-6 supports 250K, 500K or 1000Kbps. It must match the J1939 bus to ensure the communication.
- **Communication Baud Rate** – displays the baud rate for the serial port.
- **GUI Version** – displays the version of the GUI.
- **Serial Number** – displays the serial number of the specific unit, reference to the factory record.
- **Activation Date** – is the date when the module is configured first time after leaving the factory.
- **OEM Password** - the **OEM Password** is included in the GUI CD. Users may reset the OEM password. Just don't forget it.
- **Communication Port** – displays the Communication Port that the GUI is connected to.
- **Temperature Conversion Tool** - converts temperature from Celsius to Fahrenheit or vice versa.
- **Change ID or Data Rate** – loads the new settings into the unit's RAM memory and activates these values.
- **Permanently save settings.**

View Graphs

Any input and/or output can be graphed in the two windows. Each window displays up to two parameters simultaneously selected from the pull-down menus.

Each graph can be scaled individually. The graph will display the **Calculated Fan RPM** if the Gauges are toggled to **RPM** on “Dashboard”.



- **Sample Time Seconds** – bigger number slows down the speed that the graphs move along X axis.
- **Back ground Color** – click to change the background color.
- **Graphing Title** - Uncheck to remove the graph. Click or right click to format the graphing curves.
- **Log Data** – logs the operational data in .csv format.

Appendix A Fan Status Messages

The Fan Drive Message, PGN 65213, FEBD

SPN	Start bit	# bits	Parameter Name
975	1	8	Estimated Percent Fan Speed
977	9	4	Fan Drive State

The Bank 1 Status Message, PGN 45312, B100

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

The Bank 2 Status Message, PGN 45568, B200

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

The Bank 3 Status Message, PGN 45824, B300

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

The Module Status Message, PGN 46068, B400

SPN	Start bit	# bits	Parameter Name
	1	16	Ignition Input Volts
	17	16	Reverse Input Volts
	33	16	Fire Input Volts
	49	16	Supply Volts

The Bank 4 Status Message, PGN 46336, B500

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

The Bank 5 Status Message, PGN 46592, B600

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

The Bank 6 Status Message, PGN 46848, B700

SPN	Start bit	# bits	Parameter Name
975	1	8	Bank Estimated % Fan Speed
	9	16	DG State Input 1 – 16 0 = Fan is Off, 1 = Fan is On
1639	25	16	Estimated Fan RPM

NOTES:

1. The scale factor for Voltage Inputs is 0.01 V/bit with an offset of 0.
2. For more information on Suspect Parameter Numbers (SPN) refer to SAE J1939-71

Appendix B Troubleshooting Communication Port Adapters

Windows does not like Com ports with the same name, and some devices might hang onto a com port when not in use. Here is how to clean and remove problem ports.

Option 1

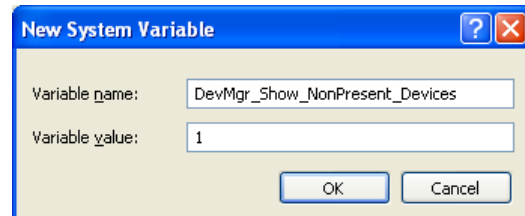
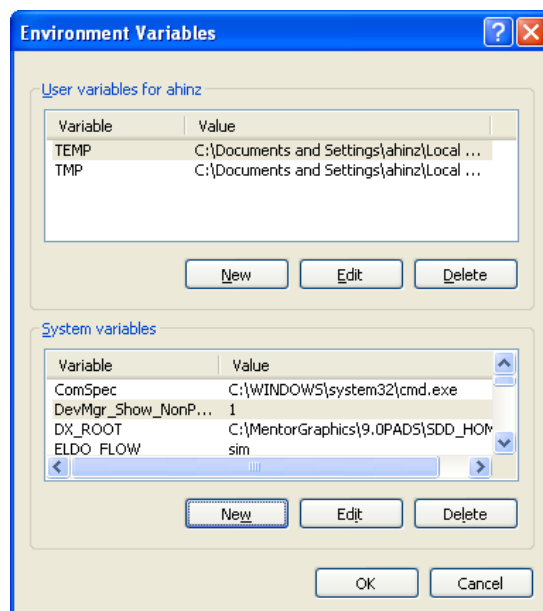
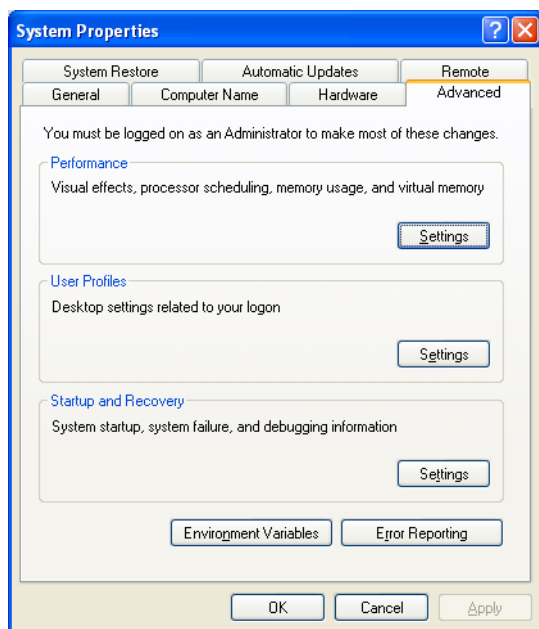
Devices that have been installed but are not currently available are "phantom devices". These devices are not usually displayed in the device manager, but can be made to be displayed.

This allows device properties to be changed or devices to be uninstalled even though the device is not physically connected to the PC.

Control Panel ⇒ System Properties ⇒ "Advanced" option and click "Environment Variables"

⇒ In the System Variables sections, click "New"

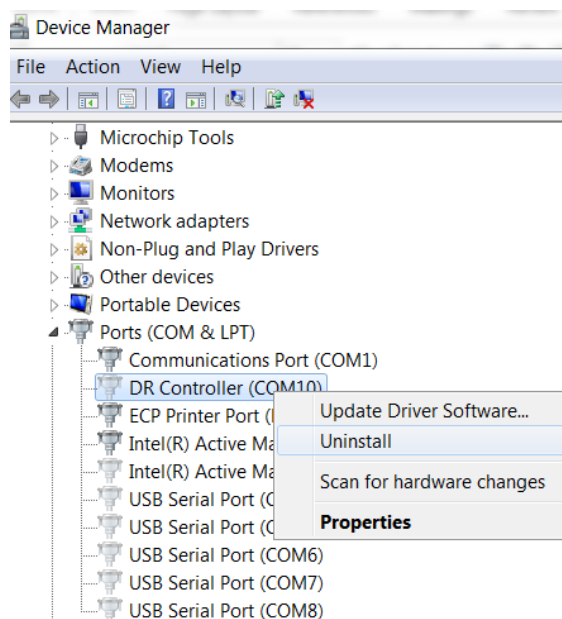
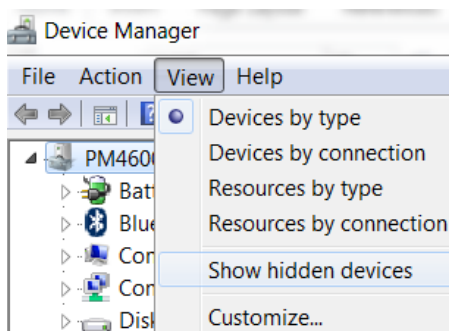
⇒ "DevMgr_Show_NonPresent_Devices" and set the value to 1 ⇒ OK ⇒ Close the System Properties panel.



- ⇒ Open the Device Manager
- ⇒ "View" ⇒ Show Hidden Devices".

Device Manager will show all hidden and phantom devices.

- ⇒ Uninstall the phantom devices by right clicking on them, and 'delete'.
- ⇒ Reboot the PC.



Option 2

Open the Control Panel: Add or Remove Programs

Remove old versions of FTDI drivers Windows Driver Package – FTDI CDM Driver Package

Reinstall the FTDI Drivers as explained in [Software Installation](#) above.

The current driver package for your operating system may be obtained directly from the vendor at <http://www.ftdichip.com/FTDrivers.htm>

- ❖ Mining & Exploration
- ❖ Agriculture
- ❖ Cranes & lifts
- ❖ Refuse & Re-cycling
- ❖ Construction
- ❖ Off-Road vehicles
- ❖ Forestry, Wood & Pulp
- ❖ Reclamation & Salvage
- ❖ Oil Field & Sands
- ❖ Demolition Equipment
- ❖ Cooling Solutions
- ❖ Military Apparatus
- ❖ Specialty Use
- ❖ Remote Control
- ❖ Power Generation
- ❖ Emission Controls
- ❖ Integrated Drivers
- ❖ Valve & Pump Controls



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 Fax: (1) 530 265 3275